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(54) Raise Bore Mining Method and Apparatus for Carrying
Out the Method

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Abstract of the Disclosure

A raise bore mining method and apparatus is disclosed. A raise is bored from one drift level to the next with a conventional raise boring machine using a string of drill pipes. On completion of the raise boring a mining assembly
5 is attached to the end of the drill string of the same or a different raise boring machine for moving the mining assembly up and down the bored raise, whereby the regular mining activities such as drilling, blasting, ground support, etc, may be performed from such mining assembly.

CLAIMS

1. A raise bore mining method comprising the steps of:
 - a) boring a raise with a conventional raise boring machine utilizing a string of drill pipes;
 - b) on completion of the raise boring, attaching a
5 mining assembly to the end of the drill string of the raise boring machine for moving the mining assembly up and down the bored raise; and
 - c) performing regular mining activities such as drilling, blasting, ground support, from said mining
10 assembly.
2. A raise bore mining apparatus comprising:
 - a) a raise boring machine which is normally used to drill a raise utilizing a string of drill pipes;
 - b) a mining assembly attached to the end of the drill
15 string of the raise boring machine for movement thereof up and down the bored raise, and
 - c) means for performing regular mining activities such as drilling, blasting, ground support, from said mining assembly.
- 20 3. A raise bore mining apparatus as defined in claim 2, wherein said mining assembly comprises fail safe spring loaded and hydraulically releases gripper pads which fix the mining assembly to the wall of the bored raise while performing mining activities or to support the mining

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assembly while removing or adding sections of drill string pipes on the boring machine.

4. A raise bore mining apparatus as defined in claim 3, wherein the mining assembly is made in two superposed sections interconnected by hydraulic or air cylinders which permit a blasthole drill mounted on the lower section to be displaced along the raise without moving the mining assembly as a whole.

5. A raise bore mining apparatus as defined in claim 4, wherein each section is provided with spring loaded and hydraulically released gripper pads, whereby by alternately gripping and releasing the gripper pads of one section versus those of the other section, and operating the cylinders, the mining assembly can be moved along the bored raise if required.



RAISE BORE MINING METHOD AND APPARATUS FOR
CARRYING OUT THE METHOD

This invention relates to a raise bore mining method and an apparatus for carrying out the method.

Raise boring has been successful in virtually all types of rock. Modern raise boring machines are able to drive
5 10-12 ft. diameter raises at a rate of up to 1000 ft. per month. The known raise boring machines are capable of drilling a pilot hole of up to 300 meters and then reaming the pilot hole out to 10-12 ft. On completion of the raise reaming, a rail such as the one developed by Linden-
10 Alimak AB is installed on the hanging wall of the raise and a drill rig such as the one developed by Tamrock, Finland for the Swedish Viscaria Mine, is mounted on the rail. Using the Tamrock-Viscaria rig, horizontal or inclined fan patterns of blastholes are drilled from the
15 rig. The drill rig has an automatic rod changer which allows up to 100 feet of 4 inch diameter blastholes to be drilled. The drill is normally controlled by a microprocessor. Drill patterns are fed to the microprocessor via a line from a central office. Thus the
20 operator does not have to control the azimuth or depth of the blastholes.

The Tamrock-Viscaria rig drills off an ore block at higher rate than any prior art conventional devices.



Varying ore shapes can be accommodated by varying the length and azimuth of the blastholes. Loading of blastholes is mechanized and highly productive. However, the Tamrock-Viscaria rig has several disadvantages:

5 1. The Linden-Alimak rail attached on the hanging wall of the raise can only handle a weight of 10 tons or so and, therefore, the drill rig has to be quite light.

2. To save on weight, the drill rig is suspended below the rig and is thus difficult to service.

10 3. A cable winch is required to move the Tamrock-Viscaria rig. Thus, there is the potential for a broken cable, winch problem, sheave failures, etc.

4. Drill vibrations can cause failure of the rail or the anchoring bolts and thus there is an additional
15 potential for failure.

5. The shape of the raise is not optimum for collaring drill holes.

It is therefore the object of the present invention to provide a new method and apparatus for the mechanization
20 of bulk mining. The method, called raise bore mining, is suitable to mine large tabular and steeply dipping ore bodies, both primary mining and pillar recovery, rapidly and economically.

The method, in accordance with the present invention,
25 comprises the steps of boring a raise from one drift level to the next with a conventional raise boring machine using

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a string of drill pipes, on completion of the raise boring, attaching a mining assembly to the end of the drill string of the same or a different raise boring machine for moving the mining assembly up and down the
5 bored raise, and performing regular mining activities such as drilling, blasting, ground support, etc, from such mining assembly.

The distance between adjacent bored raises depends on the size and geometry of the ore body and the extent of
10 the blasthole drill pattern. Permissible dip depends on the angle of repose of the muck.

By using the drill string of a raise boring machine to suspend the mining assembly, large capacity drills may be used to drill the blastholes. After reaming the raise, a
15 less expensive raise boring machine may be substituted for the purpose of raising or lowering the mining assembly.

The raise bore apparatus comprises a raise boring machine adapted to drill a raise using a string of drill pipes, a mining assembly attached to the end of the drill
20 string of the raise boring machine for moving the mining assembly up and down the bored raise, and means for performing regular mining activities such as drilling, blasting, ground support, from said mining assembly.

Fail safe security may be provided to the mining
25 assembly by means of spring loaded and hydraulically released gripper pads which fix the mining assembly to the

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wall of the bored raise while performing mining activities or to support the assembly while removing or adding sections of drill string pipes to the boring machine.

5 The mining assembly is generally made in two superposed sections interconnected by hydraulic or air cylinders to permit a blasthole drill mounted on the lower section to be displaced along the raise without moving the mining assembly as a whole. The inherent advantage of such a system is to permit the adjustment of the blasthole drill
10 elevation and the drilling of more than one row of blast-holes, and to allow greater accuracy in collaring holes. Each section is provided with spring loaded and hydraulically released gripper pads. By alternately gripping and releasing the gripper pads of one section
15 versus those of the other section, and using the cylinders, the mining assembly can also be moved along the bored raise if required.

Access of personnel and supply to and from the mining assembly may be by conventional Linden-Alimak raise
20 climbers traveling upon a rail attached to the bored raise wall. An alternative method is by using a mobile service rig capable of traveling along the drill string of the raise boring machine as disclosed and claimed in
A Canadian application No. 494,465 filed November 1, 1985

25 Additional stability of the stope walls may be achieved by cable bolting during the production phase by extending

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the regular blastholes for the installation of cable bolts.

The invention will now be disclosed, by way of example, with reference to the accompanying drawings in which:

5 Figure 1 is a cross section view of a raise bore stope;

 Figure 2 is view of a first embodiment of a mining assembly; and

 Figure 3 is a view of a second embodiment of a mining assembly.

10 Referring to Figure 1, there is shown a raise bore stope 10 through which has been bored a raise 12. It is to be understood however that a raise may be driven long enough to service several stopes along its length. The angle of dip of the raise depends on the angle of repose of
15 the muck. The raise is bored by a raise boring machine 14 suitably located in an access drift at a predetermined height above the top of the stope so as to leave a crown pillar above the stope. The raise boring machine is provided with conventional equipment capable of delivering
20 a string of drill pipes 16 for drilling a pilot hole down the stope. The pilot hole is subsequently reamed by additional equipment attached to the drill string to enlarge the pilot hole between an upper access drift 18 and a lower access drift which is later undercut as
25 indicated at 20. A haulage drift 22 provides access to the stope undercut. A mining assembly 24 is attached to the

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end of the drill string 16. A service rig 26 is mounted on a rail (not shown) attached to the hanging wall of the raise to provide access of personnel and supply to the mining assembly.

5 Referring to Figure 2 there is shown a mining assembly comprising a drill deck 30 and an operator's deck 32 supported by two rings 34 and 36 respectively. A platform 38 is attached to the top ring by three support columns 40 spaced at 120°C. The top ring is attached to the drill
10 string 16 by means of a swivel attachment 42 which prevents any rotation in the drill string to be transmitted to the mining assembly. A platform 44 is attached to the lower ring by three hollow tubes 46 also spaced at 120°C.

15 The drill deck 30 is suspended under the operator's deck by hydraulic or air cylinders 48 mounted on lower ring 34 and having their pistons 50 connected to the platform 38. This permits the drill deck to move along the raise independently of the operator's deck and thus
20 adjustment of the elevation of the drilling equipment and drilling of more than one row of blastholes without having to move the mining assembly as a whole.

 Spring loaded and hydraulically released gripper pads 52 are mounted on the upper and lower rings. The gripper
25 pads fix the mining assembly to the wall of the bored raise while performing mining activities and are used to

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support the assembly while removing, or adding sections of drill string pipes to the boring machine. Furthermore, by alternately gripping and releasing the gripper pads of the lower ring with respect to those of the top ring and
5 operating the cylinders 48, the mining assembly can be moved along the bored raise if required. There is at all times at least one set of grippers activated to ensure the safety to the mining assembly. Support columns 40 extend to the bottom of the drill deck through tubes 46 and serve
10 as guides to the lower ring.

The platform 38 of the operator's deck 32 may be provided with rollers 53 to guide its passage along the bored raise wall in inclined raises. An operator's cabin 54 is mounted on three cylinders 56 which serve to level
15 the cabin in inclined bored raises. A power unit 58 is also mounted on cylinders 60 for the same purpose.

Ladders 62 connect the two decks of the mining assembly.

A conventional drill rig 64 is suspended from the lower
20 ring via an articulated arm 66. The arm may be rotated in a horizontal plane by means of a shaft 68 and locked in position with a disk brake 70. The drill rig may be pivoted in the vertical plane by means of an articulated arm 72 and cylinder 74. A cylinder 76 operating a pad 78
25 applies a compensating force on the bored raise wall while drilling.

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As shown in Figure 1 of the drawings, the blast hole drill may be used to drill holes for installing cable bolts 79.

Referring to Figure 3, there is shown a second embodiment of a mining assembly comprising an upper ring 80 and a lower ring 82 connected by cylinders 84 permitting the lower ring 82 to move independently of the top ring 80 for the same purpose as in the first embodiment of the mining assembly. Three support columns 86 spaced at 120° are fixed to the lower ring and pass through the upper ring to serve as guides for the movement of the upper ring. Each ring is mounted with fail safe spring loaded and hydraulically released gripper pads 88 which serve to fix the mining assembly to the bored raise wall. Rollers 90 mounted on each ring permit the movement of the rings without damaging the pads. As in the first embodiment, by alternately gripping and releasing the gripper pads on the lower ring with respect to those of the top ring and operating the cylinders, the mining assembly can be moved along the bored raise if required.

The drill string 16 of the raise boring machine is attached to the upper ring 80 of the mining assembly through a swivel attachment 92 which prevents any rotation of the drill string to be transmitted to the mining assembly.

A power unit 94 is mounted on the lower ring.

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A drill ring 96 and an operator's cabin 98 are supported underneath the lower ring. Both drill and operator's cabin are able to rotate in a horizontal plane via a turntable 100. A ball and socket attachment 102 and
5 a pair of levelling cylinders 104 serve to level the turntable. A work platform 106 is also suspended under the lower ring via columns 108. The work platform can be leveled by ball and socket attachment 110 and cylinders 112.

10 The blasthole drill mounting assembly is designed to permit a horizontal offset so that obstacles such as columns 108 can be avoided. The blasthole drill is of conventional type.

Drilling is preferably carried out from higher to lower
15 elevations and controlled by a microprocessor so that the operator does not have to set the azimuth or depth of the blastholes. Drill patterns may be fed to the microprocessor via a line from a central office.

At the start of the drilling cycle, the gripper pads
20 on the upper and lower sections of the mining assembly are extended against the rock. Once a complete row of blastholes is drilled off, the gripper pads on the lower section of the mining assembly are retracted and the cylinders are extended to the preset location of the next
25 row of blastholes and so on until full extension of the cylinders is reached. Once the full extension of the

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cylinders has been reached, the gripper pads on the lower section are applied and those on the upper section retracted so as to allow the raise boring machine to add additional raise bore drill pipes for lowering the mining
5 assembly. The above drilling operation can be completely mechanized and automated.

Once the complete stope is drilled off, the mining assembly may be removed and replaced by a blasting platform but the mining assembly is preferably used for
10 loading the blastholes and blasting. Loading and blasting is preferably carried out from the bottom to the top of the raise. Loading and blasting can also be mechanized by using bulk explosive which would be blown through a hose from one level above and detonated using conventional
15 detonators, thus minimizing material handling.

The main feature of the present invention is that it permits mining of an ore body from a bored raise using a mining assembly which is suspended from the drill string of a raise boring machine. The mining assembly may be moved up and down the bored raise using the raise boring
20 machine. This feature allows no practical weight limitation for the mining assembly. This is a marked improvement over the Tamrock-Viscaria rig which is limited by the load handling capacity of the Alimak rail used to support the drill rig in the bored raise.

25 Another advantage of the present invention is the use

of a mining assembly having two independent sections interconnected by cylinders which allow drilling of several rows of blastholes without moving the mining assembly as a whole.

5 Additional advantages of the present invention are as follows:

1. Mining assembly is completely mechanized and can be automated with present technology.

2. Mining method is suitable for remote control
10 mining such as in radio active or high stress areas.

3. Fewer accesses are required thus reducing development cost. This becomes significant in high stress or high temperature areas where conditioning of accesses is a major expense.

15 4. Driving of a bored raise is fast and safe. A bored raise is also easier to condition than conventional drill and blast raises.

5. Collaring of drill holes will be easier since a drill located in the center of a circular bored raise will
20 always be at right angle to the raise wall. Ease at collaring increases blast hole accuracy.

6. The platform under the drill rig on the mining assembly provides access to drill for sampling and maintenance.

25 7. Different options exist for driving the raise such as reaming from top to bottom, or bottom to top, driving a

box hole raise, or using a tunnel boring rig, all of which gives more flexibility to the method.

8. During the moving cycle, the mining assembly is always supported by two methods: either two sets of grippers pads both of which are designed to support the total weight of the mining assembly plus the raise boring machine drill string, or the boring machine drill string plus one set of gripper pads while a portion of the drill assembly is being moved.
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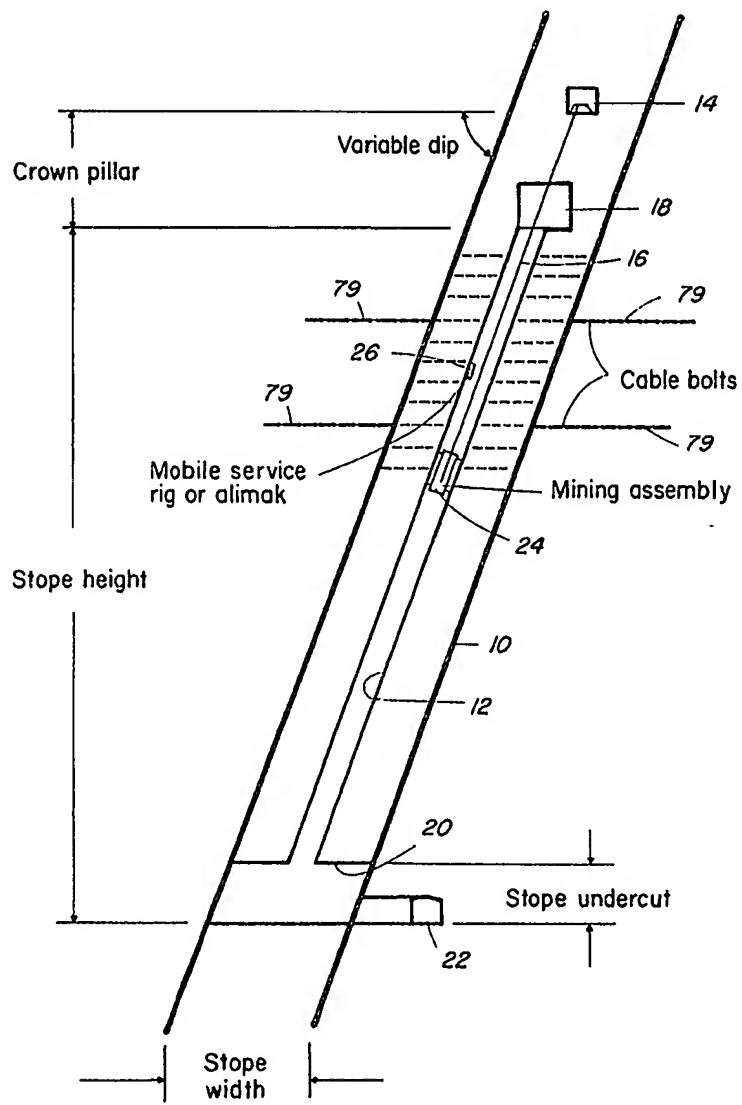


Fig. 1

Pumote, B.

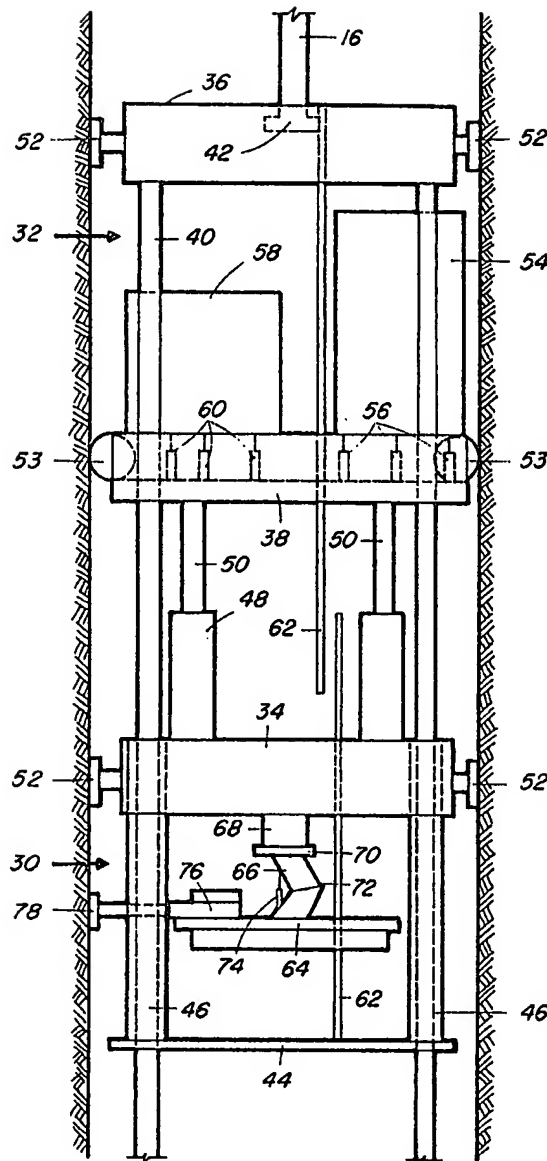


Fig. 2

Pumuck & Co.

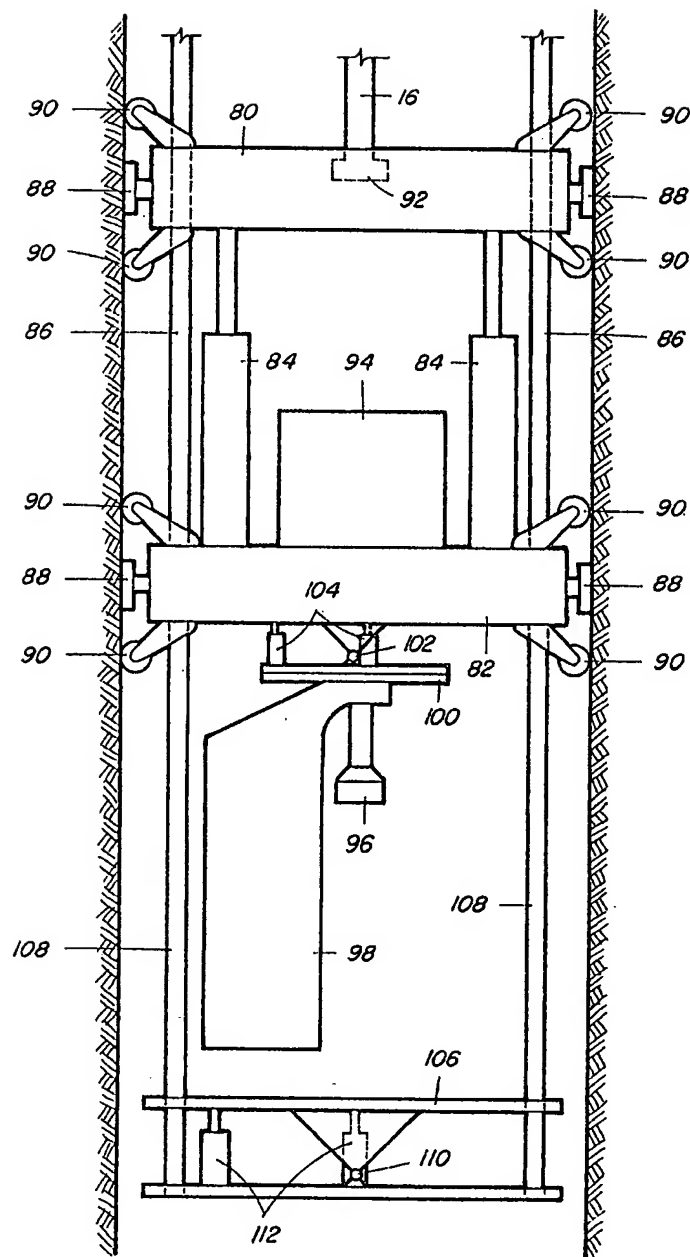


Fig. 3 *Perkins & Co.*